

SLIDE RULE FOR MUSIC

The present invention relates to a slide rule for music and in particular, but not exclusively, to a slide rule for indicating musical intervals, scales and chords.

- 5 It is known that devices exist for calculating the notes to be played in different scales and chords in different keys. However, such devices generally fail to demonstrate the interval structures that are inherent in all forms of music or to integrate the visual aspects of written music (of the western system) in a single unit that not only provides information but also promotes a conceptual understanding in the user.

- 10 US-A-5524522 describes a music learning aid having a base and a sliding template, which has windows that allow viewing of musical information imprinted on the base.

US-A-5415071 describes a slide rule for producing musical note relationships, including an inner member that carries an array of symbols representing notes and a sliding cursor that indicates scales and modes.

- 15 The need for a device that presents this information clearly derives in part from the fact that both linguistically and visually on the stave, the twelve tones that make up the western chromatic scale are for historical reasons represented by only seven letters (or eight in German), which are primarily assigned to the irregular sequence of notes known as the Major scale. This creates the need for additional symbols (sharps and
20 flats) to compensate for the deficiency in names. The result is a confusing multiplication of names (a minimum of 21 enharmonic names for the twelve notes and 30 key names).

- In written music, the lines of the staff or stave and the spaces between them represent the notes of the major scale in the key of C. However, the musical intervals between
25 these notes are not all equal. Further, each note alternates between being positioned on a line and in a space with every octave above or below its starting position. There is therefore much in the system that is confusing and obscures what might otherwise be quite simple to understand and learn. For example, it is not immediately apparent from looking at written music or the finger positions on a keyboard (and many other
30 instruments) that the whole tone intervals say E-F# and F-G are the same.

It is an object of the present invention to provide a slide rule for music that mitigates at least some of the afore-mentioned problems.

According to the present invention there is provided a slide rule for music, the slide rule including at least some of the features described herein.

- 35 The slide rule serves to reveal the interval structures of scales, chords and modes in a simple visual analogy to music whilst at the same time referring to the conventional

system of musical notation. It also serves for performing a wide range of musical calculating tasks in a way that can be seen and understood.

The invention provides a conceptual system and a number of possible devices or
5 embodiments that deliver the system to the user. The concept is to represent musical intervals in linear form with each semitone given an equal linear distance. The fixed interval structures of scales, chords and modes of any sort may thus be seen without requiring the ability to read music. It is also possible to represent visually in chart or grid form the provenance of all diatonic chords so that their relationships to the major
10 and minor scales and to each other can be seen and comprehended without the need for a lengthy explanation of musical theory.

Preferably, the invention provides a slide rule for scales, chords and modes, which shows what notes are played in any key by providing a fixed reference scale with the
15 symbols for the notes in chromatic order over a distance of at least two octave spaces, i.e. 25 semitone spaces, against which a chart or rule may pass that has divisions of the same length, said divisions being filled with colours, symbols or numbers to represent any continually ascending or descending sequence of notes. Thus the degree of the major scale can be represented by colouring in the 1st, 3rd, 5th, 6th, 8th,
20 10th, 12th and 13th spaces. Then by moving this rule or chart horizontally adjacent to the fixed scale one can see which notes would be played in any key. The tonic or first note would act as a key cursor against the letters of the chromatic scale.

An embodiment of the invention will now be described, by way of example, with
25 reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of the slide rule;

Fig. 1a is an exploded view of the slide rule;

Figs. 2a and 2b are side and end views respectively of an innermost cylinder, which
30 will be referred to hereafter as the scale/mode cylinder;

Figs. 3a and 3b are side and end views respectively of an intermediate sleeve, which will be referred to hereafter as the key cursor sleeve;

Figs. 4a and 4b are side and end views respectively of an outer cylinder;

Figs. 4c-4j show detailed views of the end rings;

35 Figs. 5a and 5b are side and end views respectively of the assembled slide rule;

Figs. 5c-5f show cross sections taken through the middle of the three cylinders;

Fig. 6 is an end view on an enlarged scale of the assembled slide rule;

Figs. 6a-6h are views of the end pieces and end caps respectively;

- Fig. 7 is a cross-section on line VII-VII of Fig. 6;
Fig. 8a is a perspective view on an enlarged scale of the key cursor sleeve;
Fig. 8b is a cross-section through the key cursor sleeve;
Figs. 9a, 9b and 9c illustrate the charts attached to the outer surfaces of the scale/mode
5 cylinder, the key cursor sleeve and the outer cylinder respectively;
Figs. 10a, 10b, 10c and 10d are perspective views of a set of optional transposition
clips;
Fig. 11 is an illustration of the transposition clips in use on the slide rule;
Fig. 12 is an illustration of an optional guitar fingering sleeve in use on the slide rule;
10 Fig. 13 is an illustration of the slide rule, showing the degrees of the scale of C Major;
Fig. 14 is an illustration of the slide rule, showing the dominant chord in the key of
Bb Major;
Fig. 15 is an illustration of the slide rule, showing the Pentatonic and Blues scales in
the key of C;
15 Fig. 16 is an illustration of the slide rule, showing the pitch range of various orchestral
instruments and the key signature cursors, and
Fig. 17 is an illustration of the slide rule, showing use in a transposition mode.

As shown in Figs. 1 and 1a, the slide rule comprises three concentric cylinders, those
20 being the scale/mode cylinder 2, which is the innermost of the cylinders, the key
cursor sleeve 4 and the outer cylinder 6.

The scale/mode cylinder 2 is shown in Figs. 2a, 2b and comprises a cylindrical body
10 and an inner spacing tube 11 which is held in place by the end pieces 12. The end
25 pieces 12 have an outwardly extending flange 13 which is stepped in two diameters
13a, 13b. Flange 13a acts both as a locating stop for its insertion into the inner
cylinder 2 and on its outer surface as a bearing for the middle cursor cylinder 4.
Flange 13b holds the middle cylinder 4 in position and is a positive locating stop for
the end caps 14.

30

The caps 14 may be removable, so allowing the interior of the cylinder 2 to be used
as a storage compartment, for example for pencils, cleaning materials and removable
parts of the slide rule. To this end, the spacing tube 11 provides an even inner surface
with the adjoining end pieces 12 to prevent objects, especially rolled paper, from
35 becoming trapped in the inner cylinder 2.

The outer surface of the body 10 is covered with the chart 16 shown in Fig. 9a (see
also Fig. 7).

The key cursor cylinder 4 is shown in Figs. 3a, 3b and Fig. 8. It is to be made of a transparent plastic so that a longitudinal window area 18 may be provided, allowing a view to the chart 16 on the scale/mode cylinder 2. On either side of the window area 18 there are provided two external guide ridges 19 running the length of the cylinder to prevent rotational movement in relation to the outer cylinder 6. On either side of the guide ridges 19 there are provided friction pads 20 made of a suitable material to control the lateral movement between the cursor cylinder 4 and the outer cylinder 6. They will also act as stops to definitively limit such movement (as either end engages with the stop tabs 26b on the end rings 26 of the outer cylinder). Three internal ridges 21 are provided to prevent the inner surface of the cursor cylinder 4 from binding on the outer surface of the inner cylinder 2. The chart 22 covers most of the outer surface of the cursor cylinder 4 and has a cut out area 23 to accommodate the friction pads 20. The window area 18 is left clear of any covering.

The outer cylinder 6 is shown in Figs. 4a, 4b and comprises a transparent cylindrical tube 24 having an end ring 26 at each end. The outer surface of the outer cylinder 6 is partially covered with the chart 27 shown in Fig. 9c. Inwardly-extending guide ridges 28 run the length of the cylinder 24 with a channel 29 between them. Contiguous with the internal guide ridges 28 and the channel 29, a shallow outwardly extending profile 30 is provided on the outer surface of the cylinder which defines the limits of the main window 31 and locates at either end in recesses 26a provided in the end rings 26. Two internal spacing ridges 32 are provided on the inner surface of the cylinder 6, which extend inwardly to the same depth as the guide ridges 28.

The guide ridges 28 as illustrated are the outside edges or feet of an arc shaped cross section so that in effect it is only the outside edges that make contact with the surface of the cursor cylinder 4 and the guide ridges 19 on either side of the cursor cylinder window area 18. The arch profile or channel 29 is the inside surface of the main outer cylinder window 31. Thus the outside surface of the cursor window 18 and the inside surface of the window 31 are prevented from coming into contact with each other.

The outer cylinder 6 fits around the key cursor cylinder 4, as shown in Figs. 6 and 7, so that the guide lug 28 locates between the guide ridges 19 on the cursor cylinder. This prevents rotation of the outer cylinder 6 relative to the key cursor sleeve 4 but allows limited axial movement between those two parts, the extent of movement being restricted by the end edges of the friction pads 20 coming into contact with inwardly facing stop tabs 26b on the end rings 26.

The construction of the slide rule thus allows rotation of the scale/mode cylinder 2 relative to the key cursor sleeve 4 and the outer cylinder 6, and axial movement of the outer cylinder 6 relative to the scale/mode cylinder 2 and the key cursor sleeve 4.

5

A set of windows is provided in the outer surface of the outer cylinder 6. These windows are formed by providing apertures in the chart 27, as shown in Fig. 9c, so that portions of the scale/mode cylinder 2 and the key cursor sleeve 4 can be seen through the transparent outer cylinder 6.

10

The first window 31 extends along the length of the outer cylinder 6 and is aligned with the window 18 in the key cursor sleeve 4, thus allowing the first chart 16 on the scale/mode cylinder 2 to be seen. This window is formed between the upper and lower edges of the chart 27, the height of which is slightly less than the circumference of the outer cylinder 6.

15

The first window 31 displays the notes contained in any chosen scale, mode or chord. The type of scale, mode or chord is selected by rotating the scale/mode cylinder 2, and the key of that scale, mode or chord is selected by sliding the scale/mode cylinder 2 and the key cursor sleeve 4 axially relative to the outer cylinder 6.

20

Two further longitudinal windows 34, 36 are provided above and below the first window 31. These windows allow parts of the second chart 21 on the key cursor sleeve 4 to be seen and display key cursor and reference information, the upper window 34 indicating the degrees of the major and minor harmonic scales and the lower window showing reference numbers one to twelve repeating over the length of the display.

25

A first circumferential window 38 is provided towards the right-hand end of the slide rule. This window allows the second chart 21 on the key cursor sleeve 4 to be seen and displays key signature indicators.

30

A second circumferential window 40 is provided towards the left-hand end of the slide rule. This window 40 also allows the second chart 21 to be seen and displays the pitch range of various orchestral instruments.

35

The information printed on the three charts 16, 21, 27 will now be described in more detail with reference to Figs. 9a, 9b and 9c.

The first chart 16 (fig. 9a) displays in linear form the structures of scales, chords and modes. There is a grid of thirty six horizontal lines 41 and thirty seven vertical columns 42 of cells 43, which can be viewed one or two lines 41 at a time (through the first window 31 in the outer cylinder 6) by rotating the ends of the scale/mode cylinder 2. By pushing or pulling the ends, the scale/mode cylinder 2 can be made to slide backwards or forwards in relation to the outer cylinder 6 so that the scale, chord or interval chosen can be aligned with the notes and/or key of choice.

- Each cell 43 represents either a note position or a semitone interval. A cell may be filled with colour and numerals 43a or be highlighted with a coloured border 43b. A scale chord or mode can be represented by filling the appropriate sequence of cells with colours numbers or symbols. In fig. 9a, lines 10 and 11 show the degrees of the minor harmonic and major scales respectively. The cells with roman numerals for the degrees of scale are preferably coloured as in 43a, the numbered cells on line 10 being coloured blue and those on line 11 being coloured red. The seven lines above line 10 show the structures of the chords based on the degrees of the minor harmonic scale and the seven lines below line 11 show the structures of the chords based on the degrees of the major scale. The cells representing the root notes 43a of each chord are preferably filled with the colour relating to the type of chord i.e. red for major, blue for minor, green for diminished and brown for augmented, and contain the numeral 1 and are arranged so that the root cell 42a is vertically above or below the appropriate degree of the scale. The cells of the 3rd 5th and 7th notes can be highlighted 43b .
- The left hand column 42a can act as a key cursor and also contains the roman numerals relating to the degrees of scale for the appropriate chord lines.

- Lines 44 and 45 can be drawn linking the various notes within a chord structure so that the pattern of the various types of chord can be quickly recognised. Preferably these lines should be colour coded either for chord type e.g. Major, minor, diminished or augmented, or, as illustrated in Fig. 9a, according to interval length. The advantage in the latter method is that it can instantly be seen that the intervals between the 1st and the 3rd notes and the 3rd and the 5th notes and the 5th and the 7th notes in all the chords are either minor or major 3rds, thus incidentally only requiring two colours. For example the lines 44 linking the first, third, fifth and seventh notes of the chords built on the leading note of the minor harmonic scale (line 3 on chart 16) are all the same length (and colour) spanning two empty cells 43 between notes. They are minor thirds (coloured blue) and make the diminished 7th sequence. The line 45 linking the

- 1st and the 3rd notes of the chord built on the submediant of the minor harmonic scale (line 4 on chart 16) spans three empty cells between the notes and represents a Major 3rd and should preferably be coloured red. The next linking line between the 3rd note and the 5th spans two spaces (blue) representing a minor 3rd. Thus the mark of a major triad is seen to be a (red) three spaces major 3rd line followed by a blue two spaces minor 3rd line, while conversely a minor triad is represented by a blue minor 3rd line followed by a red major 3rd line. In the case of the triad 1st, 3rd and 5th on the mediant of the minor harmonic scale (line 7) the lines between the notes will both be red denoting an augmented chord. It is thus also easy to see what kind of chord an inversion would produce. Thus one can know the type of chord in root position from the colour of the cells of the 1st, 3rd, 5th and 7th notes and from the sequence of the linking lines as well as seeing what type of chords would be produced by inversions and other combinations of notes in the sequence.
- Although not shown in Fig. 9a on account of the fact that colour cannot be used in these illustrations a preferred option is the use of vertical linking lines preferably broad and of a pale neutral hue such as grey that can be seen passing behind the coloured horizontal lines but not confused with the other markings. These lines link vertically between the cells of the degrees of the minor and Major scales (lines 1 & 2 and 10 & 11) and the root notes of each chord (lines 3 - 9 & 12 - 18). They are a visual aid to tracking the connections a particular note may have with other chords when scrolling (by rotation) up and down the inner chart 21, which can be helpful when modulating.
- The second chart 21 functions as a key cursor for the various scales and note sequences on the scale/mode cylinder 2. Its movement in relation to the outer cylinder 6 is purely axial. The information revealed through the windows in the outer cylinder is as follows:
1. Key cursor. The orange bands 46 that appear in the windows 34, 36 in the outer cylinder 6 indicate the key. The blue band 48 indicates the position of the relative minor. The Roman numerals 50 are the degrees of the major and minor harmonic scales starting with the tonic (first note) on the key cursor. This acts as a reference when looking at chord structures. The roman numerals are preferably coloured with for instance red for the major scale and blue for minor third 50a and minor sixth 50b. Optionally and perhaps preferably the two scales could be separated instead of being shown combined as they are in Fig. 9b. The Arabic numerals 51 that

appear in window 36 are for chromatic reference when looking at scales and chords in the main window 31.

2. Pitch ranges 52 of orchestral instruments and conventional singing voices
5 soprano, alto, bass etc appear in window 40 in the outer cylinder 6. The
yellow and red bands on either side of each name indicate the range against the
lettering on the outside edge of the window, which are in turn aligned with
stave lines in the treble, alto, tenor and bass clefs so that one can see at a
glance which would be the most appropriate clef for a given instrument. The
10 text 52b shows various representations of octaves in relation to middle c
according to different national systems.
 3. Key signature indicators. Red and blue arrows 54 which appear in window 38
15 on the outer cylinder 6 point to the appropriate key signatures for the selected
note or key.
 4. Colour code. A boxed area 56 at the left end of the sleeve 4, which only
appears when the sleeve is extended a little to the left from the outer cylinder
6, explains the significance of the colours used on the first chart 16.
20
- The third chart 27 serves as a fixed reference and data sheet. It provides the three
longitudinal windows 32, 34, 36, which display the contents of the inner cylinder 2
and the key cursors on the sleeve 4, the first circumferential window 40 at the left end
through which the pitch range of the various instruments of an orchestra can be seen,
25 and the second circumferential window 38 in which appear the red or blue arrows 54
to indicate the key signatures that correspond to the note that has been selected. Red
is for major keys and blue for minor keys. The chord colour code 57 is also displayed
for easy reference.
- 30 The information provided on this sheet comprises:
1. The 15 key signatures 58 and their 30 names in treble, alto and tenor clefs.
 2. The relationship 60 of the clefs to each other and middle C.
 3. The position 62 of the notes on the stave in both tenor and bass clefs over a
35 range of six octaves.
 4. The letter names 64 of the notes displayed enharmonically in two adjacent
lines and corresponding to the musical notation, showing the positions of the

accidentals. (This is like a keyboard that has been spread out to give each semitone note an equal status).

5. A grid 66 showing the actual number of sharps or flats in any key as well as the number that appear in the key signature. This again is linked to both the notes on the stave lines and their corresponding letter names.
6. A reference 68 to pitch in cycles per second at octave intervals above and below middle C in relation to the staves in all clefs.

The slide rule may optionally include a set of removable outer sleeves, shown in Figs. 10a-d and 11. These include an inner sleeve 70 and an outer sleeve 72, each of which is made of a resilient, transparent plastics material and is cylindrical in shape but includes a longitudinal slot 74, allowing the sleeve to flex so that it can be clipped onto the body of the outer cylinder 6. One or both of the sleeves 70,72 may include on its inner surface a pair of strips 76 of rubber or like material that extend parallel to the edges of the slot 74, to prevent unintentional slipping of the sleeves. On the outer surface of the sleeves 70,72 markings 77a, 77b may be provided on the inner and outer sleeves for transposition and reference purposes, an area 78 may be treated to accept ink or pencil, so that the user can mark his or her own sequence of notes, for example for displaying transpositions and inversions and for comparing sequences in reverse, and markings 79 may be provided indicating, for example, the intervals of a major scale, a chromatic scale and/or other information. In the arrangement shown in Fig. 11, markings 77a on the inner sleeve 70 are in the position of F below middle c on the bass clef, and marking 77b on the outer sleeve 72 are in the position of c' on the treble clef.

Another optional sleeve 80 for showing guitar fingerings is shown in Fig. 12. This sleeve 80 extends over the full length of the outer cylinder 6 to prevent it sliding axially.

Various possible uses of the slide rule are shown in Figs. 13 to 17. In Fig. 13, the degrees of the scale of C major over a span of three octaves are seen at A in the first window 32, which also shows the line number 42. The key cursor 46 and degrees of the major scale as well as the relative minor scale on the cursor sleeve 21 are seen at B in the upper window 34, and act as a reference when the inner cylinder is rotated to show chords. The key cursor 46 and the reference numbers 1-12 are seen at C in the lower window 50b. The position of the relative minor 48,48b is also indicated, and the key signature is indicated by the indicator 54,

In Fig. 14, the dominant chord in the key of Bb major can be seen in the first window 32, the dominant 7th being emphasised. The key of the chord (F major) is also shown at D and the triad formed by the 1st, 3rd and 5th notes is linked by red lines at E to show that it is a major chord. Through the upper window 34 it can be seen at F that the dominant chord is based on the fifth degree of the scale. It can be seen easily from the even spacing of the 3rd, 5th and 7th notes that inversion is a diminished triad - in fact the notes A, C and Eb are the same as the minor Bb diminished chord on VII^m. This may be verified by twisting the scale/mode cylinder 2 back one line. Also, it can be seen at G that the 5th, 7th, 9th triad (C, Eb, G) is a minor chord whereas the 7th, 9th, 11th triad would be a major chord.

Fig. 15 shows the Pentatonic scale (line 19) at the same time as the Blues scale (line 20) in the key of F# or Gb, in which the Pentatonic is played using all the black notes of a keyboard. It can be seen that the Blues scale is the same apart from the addition of one extra note (in this case A), which is a white key.

Fig. 16 shows at H the key signature cursors aligned with the key signatures of A#/Bb minor and Bb Major. The pitch range of the trombone and the bass are also shown at I, relative to middle C and the clefs.

Fig. 17 illustrates use of the slide rule in transposition mode (lines 35 and 36). To transpose from Bb to F, Bb on line 36 (chromatic b's) is aligned with F on the outer scale. By reading across from the inner to the outer scale it can be seen that C becomes G, D becomes A, Eb becomes Bb and so on.

To summarise, the slide rule has a large number of functions including the following:

- 1) Can show the notes played in any scale within the span of three octaves in all keys.
- 2) Can show the notes played in any chord in all keys.
- 3) Shows the possible names and key signatures in any clef for the above.
- 4) Shows the intervals in all modes and chords in linear and numerical form so that their patterns can be recognised and learned.
- 5) Shows the names and ranges of the intervals within an octave. (12 intervals and 22 names).
- 6) Can show the harmonic series from octave to 16th.
- 7) Allows transposition to or from any key to any other.
- 8) Shows related keys.

- 9) Shows the pitch range of orchestral and other instruments and voices.
- 10) Gives a graphic display of the relative positions of the sharps and flats in the chromatic scale together with the enharmonic notes.
- 11) Displays the relationship of the clefs to middle C and each other.
- 5 12) Shows where the notes are placed on the stave in the treble and bass clefs with an easy means of seeing where they would be in the alto and tenor clefs.
- 13) Shows whether the number of sharps or flats in any key signature corresponds with the actual number of accidentals (black notes on a keyboard) in any key.
- 14) Makes it possible to compare intervallic structures easily without the necessity
10 of first being able to read music.
- 15) Modulating and finding cadences is made easy.
- 16) Shows the number of cycles per second or Hz numbers at octave intervals in relation to the clefs and pitch range of the orchestra.
- 17) Allows for inclusion of one's own entry - which could be a non-western scale
15 like an Indian raga - indicating where a quarter tone would be.
- 18) Generally demystifies and clarifies many of the linguistic anomalies that occur in musical terminology.

Various modifications of the slide rule are possible, some of which are described
20 below.

The colour code used could be changed.

Instead of three cylinders, the slide rule may include only the scale/mode cylinder 2,
25 and the outer cylinder 6, the scale/mode cylinder 2 being arranged to rotate and slide axially relative to the outer cylinder 6 and the key cursor sleeve 4 being omitted. The outer cylinder may be made of a transparent plastic material so that it can have a window along its length through which it is possible to view a portion of the inner cylinder or it may be split along its length to provide the same effect (this can be
30 achieved with a flexible plastic, which will have the property of closing in on the inner cylinder). The reference scale is placed along either side of the longitudinal window on the outer surface of the outer cylinder. There is also provided a chart in the form of a grid linking the two sets of notes from the reference scale to their corresponding representation on the stave. The scale or mode chart is printed on the
35 surface of the inner cylinder such that a line (or lines) may be selected in the window of the outer cylinder by rotating it and a different key and selection of notes can be obtained for the selected line by sliding one in relation to the other in a longitudinal

manner. This arrangement could be produced either wholly or partially on a pen or pencil.

It is also possible to provide a chart or charts in card or book form and a rule with the chromatic scale along its edges over a span of two octaves and spaced according to the principle already described with the notes enharmonically duplicated on either edge so that on one edge the accidentals will be depicted as sharps and the other edge they will be shown as flats. A slot or transparent window might be provided along the centre of the rule for the purpose of isolating a line on the chart below from those immediately adjacent. The rule would be placed on the chart wherever required. The left hand column of the grid (colour highlighted) would act as a key cursor.

Fig. 15 shows the Pentatonic scale (line 17) at the same time as the Blues scale (line 18) in the key of C in which the Pentatonic is played using all the white notes of a keyboard. It can be seen that the Blues scale is the same apart from the addition of one extra note (in this case Eb), which is a black note on the keyboard.

If the inner cylinder 2 is moved horizontally so that the note positions of the Pentatonic scale are all aligned with the black notes on the chromatic reference scale 64 the key cursors 46 will be aligned with the notes F# and Gb and in the key signature window 38 the key indicators 54 will point to the key signatures for F# Major, Gb Major and F# Minor and the 3rd note of the Blues scale will be the white note A.

The slide rule may include electronic devices such as, for example, an electronic metronome and/or a polyphonic tone generator for generating the scales, modes and chords selected by manipulation of the rule.

Fig. 17 illustrates use of the slide rule in transposition mode (lines 35 and 36). In this example, the letter 'C' on line 36 of the inner chart 16 is aligned with 'Bb' on the outer reference scale 64. To transpose from the key of C to the key of Bb, the user reads across from the inner scale to the outer. Thus D becomes C and E becomes D etc. Conversely, to transpose from Bb to C, the user looks from the outer scale to the inner. The inner cylinder may be moved horizontally and rotated to show either line 36 with the chromatic scale written using flats, or line 35 in which the chromatic scale is written using sharps so that any desired combination can be achieved.